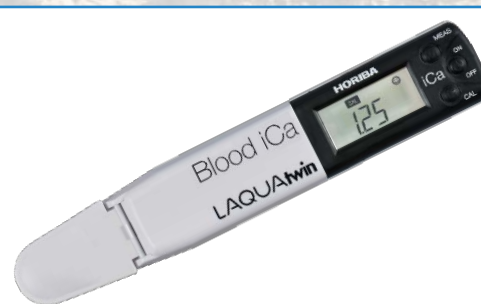


Ionized Calcium Measurement of Bovine Blood

Milk fever, or Sub Clinical Hypocalcemia (SCH) is a significant problem with dairy cows. Total calcium levels in the cows' blood drop after lactation. By measuring the ionized calcium levels of the blood directly cow side, the treatment can start sooner and is more effective.



Introduction

One of the biggest challenges for the periparturient dairy cow is the maintenance of ideal blood calcium concentrations to support milk production and immune function. Sub clinical hypocalcemia (SCH) is a prevalent condition afflicting approximately 50% of multiparous dairy cows in the early postpartum period (Reinhardt et al., 2011), and is a disorder being characterised by various research groups. Therefore, measurement of calcium to assess individual animal calcemic status and optimize preventative strategies for SCH is important.

Dairy cows experience important physiological changes around parturition. Due to the onset of lactation, leading to increased demand for Ca, blood Ca concentration decreases suddenly in the 2 to 3 days around calving (Quiroz-Rocha et al., 2009), in acute cases already in the first 6-12 hours after calving....so measuring at this point is very important to assess whether the cow might become a downer cow or not.

The animal is then affected by

hypocalcemia, which can be a clinical disease in about 5% of the cows (NAHMS, 2002), or a subclinical disease with an incidence of around 50% in cows with more than 2 lactations (Horst et al., 2003).

Despite the fact that the severity of the disease is greater in the clinical cases, subclinical cases are also important because (1) they are far more frequent, (2) they cannot be easily diagnosed, and (3) they may impair the longevity and productivity of the cow (Goff, 2008; Murray et al., 2008).

It is commonly assumed that dairy cows experience subclinical hypocalcemia (SCH) when total serum Ca is <2.0 mM (8.0 mg/dL) and clinical hypocalcemia when serum Ca levels are <1.5 mM (6.0 mg/dL; Goff, 2008), but other studies apply different ranges to determine the severity of hypocalcemia. For example, Chapinal et al. (2012) defined that a normocalcemic cow would have serum Ca levels >2.20 mM, Goff (2008) widened the criterion to a range from 2.12 to 2.50 mM, and Martinez et al. (2012) proposed >2.14 mM as the cutoff value for normocalcemia.

Current situation

Cow side calcium blood analyzer has so far not really been available for practical field conditions. The LAQUAtwin Ca-11C is currently the only reliable method for a low price per testing.

Before the release of the LAQUAtwin Ca-11-C, the only reliable alternative was the use of a Blood Gas Analyzer. These analyzers are expensive and can only be used in a laboratory. Samples must be sent to a laboratory for analysis, which takes precious time, the cost are also considerable.

The Alternative

The new LAQUAtwin CA-11C has been specially developed for cow side measurement of ionized calcium in blood. Ionized calcium reflects more accurately the current calcemic blood situation compared to total blood calcium as it equals the free available calcium ions.

The easy to use meter gives measurement results within seconds against a fraction of the cost of current measurement methods.

Research & Development

Research by the university of Cornell has proven the functionality of the LAQUAtwin Ca-11C meter for measurement of ionized calcium in bovine blood. The meters show a good relation compared to the laboratory gold standard benchtop blood-gas analyzer (fig.1).

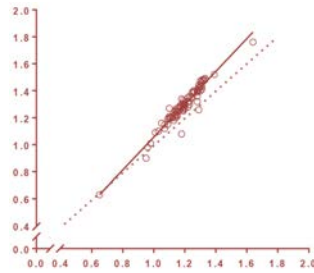
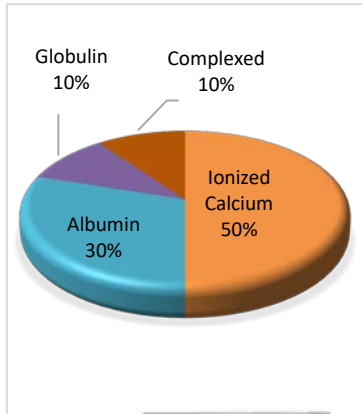


Fig. 1 Relation between reference analyzer (ABL-800 FLEX, Radiometer Medical) and the HORIBA LAQUAtwin Ca-11C @ 22°C

tCa vs iCa

The tCa value is most commonly measured, but this does not measure the active calcium (iCa) properly as iCa can transfer to and from the other bound calcium ions (complexed, Albumin, Globulin). tCa consists for about 50% out of iCa.



Method



Calibrate the meter after maximum 10 measurements. Highest accuracy when calibrated after each measurement.



Scan the QR code to watch the full measurement procedure at YouTube.

Hints & Tips

The accuracy and repeatability of the measurements depend on the how the meter is operated and maintained. This is also important for the lifetime of the Ion Selective Electrode, good care and maintenance will result in better results.

Calibration

- The more often the meter is calibrated to more accurate the readings will become.
- Always use the two standards supplied by HORIBA, other standards will not work!
- Calibrate first with 1.25 mmol/L [StP1] followed by 2.50 mmol/L [StP2]
- Only 0.5 to 1 ml of each solution is required.
- Be sure to cover the complete sensor with the solution.
- Rinse the sensor with the protein cleaning solution after each calibration point.
- Never re-use the calibration solutions.

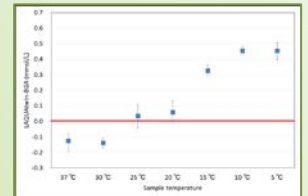
Sampling

- Whole blood and serum can be measured.
- Use lithium heparin as Anticoagulant to preserve the sample.
- Only 0.5 to 1 ml of each sample is required.

Temperature

Best results are obtained when the sample and meter are at the same temperature. Best performance will be achieved at

25 °C. In cold conditions, keep the sample in your pocket to prevent it from cooling down before taking the measurements. In hot conditions it is advised to perform the reading in a temperature-controlled location.



Storage

Store the meter in a dry place and preferably do not expose it to temperatures below 0 °C and above 40 °C. The measurement results are temperature dependent; it will take longer to get accurate measurements due to the time it takes for the electrode to reach best operating conditions.

Maintenance

- Always rinse the sensor with the cleaning solution after each measurement or calibration.
- Wipe off any residues from the sensor with a lint free tissue. Be careful as the glass sensor is only 0.8 mm thick.

Unit conversion

Conversion of ionized calcium to total calcium is roughly calculated by 2. There is no fixed and correct formula as the amount of ionized calcium is influenced by other calcium binding proteins like Albumin. Other conversions are:

- To mg/L = mmol/L x 40.08
- To mg/dL = mmol/L x 4.008
- To mEq. = mmol/L / 2



With over 70 years of engineering excellence, HORIBA's diverse range of water quality analyzers and electrodes are ideal for everyday laboratory needs through to the most demanding of applications. Visit our website for a wealth of useful information and water quality measurement tips to help you obtain the best results in your work.



RoHS

Europe, Middle East, & Africa

HORIBA UK Limited
Kyoto Close, Moulton Park,
Northampton NN3 6FL
Phone: 44 (0) 1604 542567
Fax: 44 (0) 1604 542699

e-mail: waterquality@horiba.com

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